3.4 ANIMALS AND FISH

3.4.1 Wildlife

3.4.1.1 Affected Environment

Sand Point Magnuson Park currently provides diverse wildlife habitats based on the vegetation community types present. Vegetative communities on the site are identified as lake shoreline, savannah, meadow, mowed grasslands, non-native shrub thickets (primarily blackberry), non-native trees, deciduous forest, and four wetland types, including forested, shrub, wet meadow, and seasonal marsh. Within the proposed project area, the most common existing habitat type is wet meadow complex and savannah. This cover type is a mosaic of unmowed upland meadow and wet meadow interspersed with native and introduced trees, shrubs and blackberry thickets.

Outside the immediate project area are additional habitat types that are used by wildlife species that also use habitats within the proposed project area. For example, the NOAA property to the north contains upland meadow and non-native trees (primarily Lombardy poplars) that provide prey production and perch sites for owls and other raptors. The complex of former naval station buildings to the northwest and west of the project site has structures in which barn owls are known to breed. Promontory Point to the south of the project site has a mixed native forest much larger than any of the small deciduous forest patches contained within the project area, and has been a focus of recent vegetation restoration work. Habitats within the park are quite variable, however most of those within the project site are reduced in habitat value because they support simple vegetation communities, they lack structural diversity and complexity, and the vegetation community types are relatively young (they are all early successional stages of recovery, having established subsequent to removal of the airfield).

Bird use in the park and within the proposed project area has been documented by the Seattle Audubon Society (SAS), which conducted monthly bird surveys from December 1995 to the present (unpublished data). The SAS also commissioned a wildlife habitat study (Adolfson Associates 1998). Local birders carefully watch bird use of the site (e.g., Jan Bragg, and Herb Curl, (personal communications, November 9, 2001). Seattle Audubon Society volunteers and local bird experts keep an updated list of birds observed in the park (Bragg et al. 1997). Limited data is available on documented use by amphibian and mammal species. Use was characterized based on information from the Washington Department of Fish and Wildlife (WDFW), local experts (Herb Curl, personal communication), and anticipated use by species ordinarily associated with the habitats present.

Birds

At least 156 species of birds have been observed within Sand Point Magnuson Park (See **Appendix C**, Exhibit C8; SAS, unpublished data; Bragg, 1997). Approximately 28 species of birds are year-round residents of the park, including waterfowl such as Canada geese and mallards; passerines such as robins and wrens; and five non-native species: rock dove, European starling, house sparrow, California quail, and ring-necked pheasant. With the exception of the California quail, the introduced species of birds are all habitat generalists able to adapt to a wide range of urban and suburban habitat types, which the park well represents in its existing conditions.

SAS volunteers observed 27 bird species breeding within the park and the adjacent NOAA property. The abundant meadows and shrub thickets provide opportunities for ground nesters such as the pheasant and Savannah sparrow. Ring-necked pheasants remain uncommon, and were not observed by SAS birders during monthly surveys in 2000 (SAS, unpublished data). Barn owls nested in a building on the Sand Point property to the northwest of the proposed project area in 2001 (Herb Curl, personal communication) and Bullock's orioles have been observed nesting in Lombardy poplars and native black cottonwoods throughout the park and on the NOAA property (Jan Bragg, personal communication, 2001). Other breeding birds common in the park include mallard and killdeer, which nest on the ground; bushtit, winter wren and Bewick's wren, which nest in shrubs or trees; and marsh wrens and red-winged blackbirds, which breed in emergent wetlands. Although 27 species breed in the Park, the presence of brown-headed cowbirds has a deleterious effect on breeding success. Passerine birds breeding in small forest patches (such as those found in the park) are generally more susceptible to nest failure due to cowbird parasitism than birds breeding in large, contiguous forests (Donovan et al. 1995).

A larger number of birds use the park habitats seasonally. Forty-eight bird species stop at the park during spring and/or fall migration (see Exhibit C8 in **Appendix C**). Common migrants include orange-crowned and yellow-rumped warblers. Golden crowned sparrows, cedar waxwings, ring-billed gulls, and common snipe are all winter residents. Twenty-seven species breed in the near vicinity, but haven't been documented as breeding in the park; they include the great blue heron, common tern, Vaux's swift, and violet-green swallows. Barn swallows, cliff swallows, common yellowthroat and American goldfinch all are documented to breed in the Park. The 76 species observed in the winter in the park include many species of waterfowl observed near the Lake Washington shoreline. Common winter visitors, all seen from the shoreline of Lake Washington, include the pied-billed grebe, bufflehead, American coot, double-crested cormorant, common merganser, and mew gull. Passerines such as the ruby-crowned kinglet are also common winter visitors, often seen foraging in deciduous trees and shrubs. Most of the wintering birds are seen uncommonly or rarely.

Mammals

Mammal use of the project site and surrounding area was investigated through on-site observations by Sheldon & Associates staff and previously by SAS volunteers. Many mammals that may be present on the site were not directly observed, and their expected presence was based on interpretation of common habitat associations (Larrison 1976; Adolfson Associates 1998) and the history of the site.

Approximately 33 species of mammals are expected to use the project site and surrounding habitats at NOAA and Promontory Point (**Table 3.4-1**). Coyotes were removed from the park by WDFW in about 1996 in response to neighbors' complaints about missing house cats (Herb Curl, personal communication). Coyotes are highly adaptable species and it would not be surprising if they returned. Feral house cats and rabbits or cottontails have not been seen in the park regularly for a number of years, and may have been reduced in numbers by the coyotes. Small mammals such as voles and mice are very common in the meadow and savannah habitats, as evidenced by their trails, scat and tunnel openings and as reported by others (Herb Curl, personal communication). They provide forage for nesting and migrating raptors, including red-tailed hawks, barn owls, and the occasional snowy owl. Bats are likely to inhabit the park, although they have not been directly observed. Prime forage habitats for bats include lights around buildings at Sand Point (Rydell 1992; Rydell and Racey 1995; Reihle et al. 1998) and areas near water, where insects congregate.

Table 3.4-1
Mammals Expected to Use Sand Point Magnuson Park

Species	Scientific name	Forest	Shrub	Meadow/ Savannah	Shoreline
Big brown bat	*Eptesicus fuscus*	L	L	L	L
Hoary bat	*Lasiurus cinereus*	L		L	L
Yuma myotis	*Myotos yumanensis*	X			X
River Otter	*Lontra canadensis*				P
Beaver	*Castor canadensis*				L
Muskrat	*Ondatra zibethica*				L
Townsend's vole	*Microtus townsendii*		P	P	P
House mouse (I)	*Mus musculus*		L	L	
Little brown bat	*Myotis lucifugus*	L	L	L	L
Deer mouse	*Peromyscus maniculatus*	L	L	L	L
Northwestern deer mouse	*Peromyscus oreas*	X			
Norway rat (I)	*Rattus norvegicus*	P	P	P	
Black rat (I)	*Rattus rattus*	L	L	L	L
Shrew-mole	*Neurotrichus gibbsii*		X	X	X
Coast mole	*Scapanus orarius*	X	X	X	X
Townsend's mole	*Scapanus townsendii*	L	L	L	L
Masked shrew	*Sorex cinereus*	X	X		X
Dusky shrew	*Sorex obscurus*	X	X	X	X
Trowbridge's shrew	*Sorex trowbridgii*	X			X
Vagrant shrew	*Sorex vagrans*		X	X	X
Townsend's chipmunk	*Eutamias townsendii*	X	X	X	X
Eastern gray squirrel (I)	*Sciurus carolinensis*	L	L	L	L
Douglas squirrel	*Tamiasciurus douglasii*	X			
Mountain beaver	*Aplodontia rufa rufa*	X			X
Rabbit (I)	*Lepus sp.*	X	X	X	
European rabbit (I)	*Oryctolagus cuniculus*			X	X
Eastern cottontail (I)	*Sylvilagus floridanus*		X	X	X
Opossum (I)	*Dedelphis virginiana*	L	L	L	L
Striped skunk	*Mephitis mephitis*	X	X		X
Raccoon	*Procyon lotor*	L	L	L	L
House cat (I)	*Felis catus*	X	X	X	
Coyote	*Canis latrans*	X	X	X	X
Red fox	*Vulpes vulpes*	X	X	X	X

Legend:
L likely to occur based on habitat use, site history
X expected based on habitat use, but unlikely to occur due to site history
P expected based on personal communication (Herb Curl, 11/10/01; Helen Ross, SAS, 11/9/01)
I introduced, non-native species

Introduced mammal species comprise approximately 25 percent of the mammal species expected to use the park (**Table 3.4-1**). Habitat conditions are suitable for the Norway rat, opossum, house mouse, and eastern gray squirrel, among others. House cats and off-leash dogs from adjacent residential areas and park users likely cause disturbance to native and introduced mammals at the park. Small mammals such as mice and voles are likely to be impacted most often, although their rapid reproductive rates may allow them to persist despite frequent disturbance. Aquatic species such as the beaver, muskrat, and river otter are only occasional visitors to the shoreline, as the park does not provide enough forage habitat for them. Most forest-dwelling mammals are probably absent from the park because of the small, isolated and disturbed nature of the existing forest cover in the park. Mountain beaver and Douglas squirrel are very sensitive to human presence; if present in the park, they are probably only found in the forests of Promontory Point.

Most of the terrestrial habitat in the western portion of the project site (in the area proposed for sports field development) would be for small prey species such as voles and mice. Species needing more diverse habitat structure, such as that found in the woodland of Promontory Point, would not be found in the wet meadow complex that comprises the majority of this part of the project area.

Amphibians and Reptiles

Existing amphibian and reptile use of the project site was established by direct observation and through interpretation of expected habitat-species associations, (Brown et al. 1995; Corkran and Thoms 1996) site history and land use. Based on these methods, as many as 8 species of amphibians and 8 species of reptiles may occur in the project area and adjacent habitats (**Table 3.4-2**). However, the history of disturbance at the park and the relative isolation of the park from native forest and wetland habitats make the presence of many of these species unlikely. Domestic animals disturb and hunt reptiles and amphibians, causing population declines and local extinctions (Barratt 1997). Lake Washington does not provide adequate breeding habitat for pond-breeding amphibians such as bullfrog, Pacific treefrog, Northwestern salamander, and red-legged frog, but it does provide a corridor along which dispersing amphibians and reptiles may reach the park. Habitat for amphibians and turtles on the shoreline is extremely limited, but turtles from other areas in Lake Washington may utilize the park occasionally, and likely inhabited the park historically.

Garter snakes and lizards are expected to inhabit the site, particularly around abandoned buildings and debris piles that provide cover, forage, and basking areas. Land use disturbance and domestic cats may have reduced or eliminated these populations. Amphibian use of the site is limited by the shallow, ephemeral nature of the wetlands and lack of suitable upland forest habitat for winter and summer hiding and foraging. Pacific treefrogs are easily heard during spring breeding season around a small, seasonally flooded wetland known as "Frog Pond." Approximately 2 years ago a chain-link fence was constructed around this wetland to keep dogs and human intruders from disturbing the breeding treefrogs. The treefrogs can also be heard calling occasionally during fall and winter from shrub thickets, meadow, and savannah habitats. The long-toed salamander may also be present on the site, as it breeds in shallow wetlands and requires a very small home range and little forest cover. Terrestrial salamanders such as the Ensatina and western red-backed salamander may be present in the forest area at Promontory Point; their small home range allows them to persist in small forest fragments, where they can be found living in down logs and small mammal burrows.

Table 3.4-2
Amphibians and Reptiles Expected and Observed under Existing Conditions

Species	Scientific Name	Occurrence
Bullfrog (I)	*Rana catesbieana*	X
Ensatina	*Ensatina eschscholtzii*	X
Long-toed salamander	*Ambystoma macrodactylum*	L
Red-legged frog	*Rana aurora*	X
Northwestern salamander	*Ambystoma gracile*	X
Pacific treefrog	*Pseudacris regilla*	O
Rough-skinned newt	*Taricha granulosa*	X
Western red-backed salamander	*Plethodon vehiculum*	X
Common garter snake	*Thamnophis sirtalis*	X
Northwestern garter snake	*Thamnophis ordinoides*	X
Western terrestrial garter snake	*Thamnophis elegans*	X
Rubber boa	*Charina bottae*	X
Northern alligator lizard	*Elgaria coerulea*	X
Western fence lizard	*Sceloporus occidentalis*	X
Painted turtle	*Chrysemys picta*	L
Red-eared slider (I)	*Trachemys scripta*	L

Legend:
L likely to occur based on habitat use, site history
X expected based on habitat use, but unlikely to occur due to site history
O observed
I introduced, non-native species

3.4.1.2 Wildlife Impacts of the Proposed Action

Wildlife Habitat/General Impacts

The proposed action involves the development of a large sports field complex and an extensive wetland/habitat complex, plus associated drainage and circulation facilities. These project components could create short-term impacts to wildlife during the construction period for the project, and long-term impacts through displacement or conversion of wildlife habitat and/or disturbance of species using the post-construction habitat. The primary purpose for a major component of the project, the wetland/habitat complex, is to provide a significant increase in the functions of the upland and wetland habitats found on the site.

Construction Impacts

Construction activity on the project site would occur over a span of approximately 10 years or more. Clearing, grading and other construction activities would disturb most of the acreage within the project site at one time or another during that period. These activities would result in the temporary elimination of existing vegetative cover and the wildlife habitat values that it provides. In addition, noise, dust, fumes, human presence and other aspects of construction projects would create temporary disturbance of wildlife species using the site. While construction activity would be somewhat localized within the site at any given time, the active construction sites and adjacent areas would have little or no habitat value for the duration of the activity at each site. While the total duration of the construction period would be approximately 10 years or more, the project phasing approach would result in site-specific impacts of more limited duration, and construction impacts would not extend over the entire site in each phase. The project plan provides for the retention of the physically complex upland and wetland habitats existing on the site (such as "Frog Pond," emergent marsh wetlands and upland and wetland forest stands), although species use of these habitats might be reduced during active construction in nearby locations.

Long-Term Habitat Conversion

On a long-term basis, the proposed action would convert some existing wildlife habitat to developed park uses, leave some habitat essentially unchanged, and enhance or convert other areas to improve their habitat values. These types of actions would generally result from changes to the existing vegetative cover, which were previously discussed in detail in **Section 3.3.2.2**. In summary, the most complex of the existing upland forest and wetland habitats on the site would be retained under the proposed action, while overall wildlife habitat value for the entire project site would be increased through the development of a 65-acre wetland/habitat complex (representing an increase of approximately 10 acres over the existing habitat that is roughly comparable) that would provide greater diversity and quality of habitat compared to existing conditions. Site-specific examples of habitat conversion are discussed below, while the effects of expected habitat changes on birds, mammals, and amphibians and reptiles are addressed in subsequent discussions.

The proposed action includes construction of new artificial-turf sports fields, parking lots, pedestrian ways, service facilities and landscaped areas in the western portion of the project site. Much of this area is already in developed use, has been previously disturbed, or has relatively low function for wildlife habitat. A portion of this area includes wet meadow and some scrub wetland habitats, which would be displaced by intensive park uses.

Three other small areas of existing wetland habitat would be converted to other uses for the proposed action. An existing emergent wetland located immediately north of NE 65th Street and west of Building 193 would be eliminated by parking lot and drainage feature development. Some additional wet meadow habitat, which is a mosaic of wet and upland meadow, would be eliminated along the eastern margins of the proposed sports fields. The northeast corner of the proposed field complex would also eliminate a portion of the shrub/emergent habitat that is present in the swale that traverses the site from the north to the southeast.

Balanced against these habitat losses would be a positive change resulting from the increase in acreage and diversity of wetland habitat and upland forest surrounding the wetlands. Several types of new wetland habitats would be created on the project site, including seasonally-flooded, emergent marshy pools; shallow, seasonally-flooded mudflat wetlands; ponds with deep permanent open water and vegetated margins; permanently-flooded groundwater wetlands; and a permanently-flooded lagoon open to Lake Washington with convoluted margins, emergent vegetation and overhanging vegetation. Under the proposal all of the wetland habitats would be buffered by upland forest and shrub habitats and would be linked across the landscape from the lakeshore to the existing upland forest on Promontory Point.

Human Disturbance Effects

Common types of indirect impacts of development actions on wildlife or wildlife habitat generally stem from one or more forms of human disturbance. Two aspects of the proposed action are relevant for assessing the potential for human disturbance effects on wildlife: (1) an increase in overall human use of the project site in response to increased capacity and expanded opportunities for park activities; and (2) some proposed shifts in human circulation patterns within the project site that could relate to disturbance effects. (Issues associated with potential effects on wildlife from artificial lighting, which can also be considered a form of human disturbance, are discussed subsequently under a separate heading.)

The number of recreational visitors to the project site and the total annual hours of on-site recreational use would increase dramatically with the proposed action, primarily in conjunction with the major capacity expansion represented by the sports field complex. As noted previously in **Section 3.3.2.3**, future sports field use would likely be several times larger than the current numbers. However, this large relative increase in sports field capacity and expected use would not automatically translate into large numbers of those visitors entering the wetland/habitat complex. Sports field users on site for evening games under the lights would be unlikely to visit the wetland/habitat complex, which would not be lighted and would be more difficult to negotiate. In addition, unlike other types of park visitors, sports field users would predominantly be coming to the site for late-afternoon and evening game or practice activities on a specific schedule, and would have more constraints on their time both before and after the scheduled event. Overall, sports field users would likely have a relatively small propensity (compared to other types of park visitors) to visit the wetland/habitat complex in conjunction with visits to the sports field complex.

Completion of the proposed project would likely generate increased use specifically oriented to the wetland/habitat complex. This component of the project would represent a large increase in available opportunities for passive-appreciative recreational activities such as wildlife observation, nature interpretation, environmental education, and simply walking or hiking in natural settings. These opportunities would increase the attraction of Sand Point Magnuson Park for a large segment of the recreational public that participates in these activities, and would prompt many people to come to the park specifically to visit the wetland/habitat complex, or to visit the wetland/habitat complex as a secondary activity in conjunction with use of the trails, beach area, boat launch or other resources in the park. A primary objective of the proposed project is to provide a resource base for formal environmental education programs centered on the wetland/habitat complex; implementation of these programs would generate another substantial visitor stream to the wetland/habitat complex. Considering all pertinent aspects of user, trip and resource characteristics, nature-oriented recreational visitors and environmental education participants would likely account for the largest share of future users of the wetland/habitat complex. Casual walkers would also likely generate a sizable share of the recreational use within the wetland/habitat complex.

To some extent, the potential for wetland/habitat complex visitors to disturb wildlife would depend on their behavior while in this area of the park. Project design elements and park management would actively and passively encourage good stewardship by visitors. Trails and viewing sites would provide visitors with ample opportunities to experience the wetland/habitat complex without venturing off-trail into the interior of the complex. Informational handouts and signage would encourage visitors to remain in approved locations. Park users currently have full access to the existing habitat areas within the park, and make full use of an informal trail network that extends to all areas of the park. The trail network in the proposed action has been designed specifically to avoid access to the interior habitat zones, and fencing in strategic locations would block off-trail access to more sensitive habitats. Park management staff, citizen volunteers and organized user groups would, to varying degrees, help to monitor user behavior and reinforce communication about proper use and care of the resource. On balance, there is reason to believe that the vast majority of visitors to the wetland/habitat complex would behave responsibly, which would help to minimize or avoid adverse human disturbance impacts on wildlife using that complex.

Some wildlife species are relatively sensitive to the presence of humans. These species do not use the project site at present, and they would not be expected to use the proposed wetland/habitat complex because of the likely presence of considerable numbers of people.

Two aspects of the proposed action would cause shifts in human circulation patterns within the project site that could result in wildlife disturbance effects. Development and operation of the proposed sports field complex would cause some changes in the daily patterns of the evidence of human use within the habitat areas. The most noticeable change from existing conditions would likely be to extend artificial lighting into areas of the park where it is not now evident; this effect is discussed subsequently under a separate heading. A second change would be to increase the daily hours during which sports field noise would be audible within the adjacent habitat areas. **Section 3.6** of the EIS provides a detailed assessment of the existing sound environment for the project site and the expected sound levels resulting from operation of the proposed fields.

One key physical aspect of the proposed action would serve to eliminate a component of human disturbance effects that presently exists. The interior parking lot and tennis courts and the associated access road through the internal meadow/savannah area would be removed and replaced with native wetland vegetation. This feature of the proposed action would significantly reduce the degree of human access to the interior of the project site. In addition, the proposal would result in the removal of existing formal and informal trails accessing the interior portions of the site. Removing these existing access routes would allow for the establishment of a larger, more contiguous and diverse habitat complex area with a sizable core area free from human intrusion.

Effects of Artificial Lighting

The proposed action includes the installation of artificial lighting systems at the 11 sports fields with synthetic turf (Fields 5 through 15). Lighting system physical characteristics are described in detail in **Section 2.2.9**, their operation is summarized in **Section 2.2.13**, and most aspects of potential light and glare impacts are addressed in **Section 3.9**. The baseball/softball field lights could be used up to about 7 hours per day and about 600 hours each per year, while the soccer/rugby field lights are expected to be in use up to approximately 1,000 hours per year. The lighted fields closest to the wetland/habitat complex (Fields 6, 9, 10, 13 and 15) would use full-cutoff technology, which minimizes glare and sky glow that escapes from the fixtures and the illuminated area, but does allow more spill light. Some unintended illumination would extend beyond the playing field area toward the adjacent wetland/habitat complex. Spill light with an illuminance level of 1 foot-candle would extend for a lateral distance of approximately

135 feet beyond the fencelines of these fields, while the illuminance level would decline to 0.2 foot-candle at a distance of approximately 205 feet. (For comparison, the design illuminance levels on the playing field surfaces range from 20 to 30 foot-candles). In most locations, this 205-foot zone would overlap developed features such as the cross-country trail, the habitat area restroom and education annex, the basketball courts and park/lawn planting areas. To the east of Field 9, however, the 0.2-foot-candle level extends into the westernmost tier of the proposed marsh ponds at the edge of the wetland/habitat complex. Consequently, the sports field lighting systems would produce a dim level of artificial light for a few hours at a time on a regular basis in a small band of the proposed wetland area.

The Draft EIS presented a summary of research conclusions about the effects of artificial lighting on wildlife. Many review comments on the Draft EIS expressed concern over effects of the proposed sports field lighting on the wetland/habitat complex, including comments that specifically maintained there could be adverse effects on various types of wildlife in the complex. In response to these comments, the Department of Parks and Recreation directed the EIS preparers to investigate this issue in additional detail. The following material addresses the coverage and applicability of available research on this issue in general terms, describes how the research evidence might be related to the proposed project based on lighting characteristics, and discusses potential implications for various groups of wildlife species.

Research Coverage and Applicability

Very little scientific research exists on the direct effects of sports field lighting on wildlife populations. The literature review conducted for the Final EIS identified no research specifically on the effects of tall, shielded sports field lights on wildlife. The scientific literature that was found assessed impacts of street lights, lights associated with towers and large buildings, and lights associated with tennis courts on wildlife. Extensive querying of experts and the scientific literature failed to find any studies of effects of sports field lights on wildlife. This distinction is very important, because it prevents direct application of the research results based on other types of lighting systems to sports field lights. Street lights are typically illuminated all night long, while the proposed sports field lights would only be operated for several hours at a time. Lights on towers and tall buildings can have consequences for migrating flocks of birds that would not necessarily apply to sports field lights with much lower mounting heights. Lights on tennis courts are often not shielded, unlike the proposed sports field lights, and would have a different light dispersal pattern.

There is evidence that some sources of artificial lights could have negative impacts on most guilds of animals that could use the wetland/habitat complex at Sand Point Magnuson Park. Extensive summaries of the effects of artificial lighting resulted from a recent conference in California (Harder 2002; Longcore and Rich 2001; Urban Wildlands Group and UCLA Institute of the Environment 2002), where presentations covered research showing that artificial lights have had adverse effects on a wide range of guilds including mammals, amphibians, reptiles, fish and invertebrates. Because this research focused on specific types of artificial lighting such as street lights, however, the applicability of the conclusions to the proposed sports field lights is uncertain and subject to interpretation.

Lighting Characteristics

The perception and potential response of wildlife to artificial lighting appears to depend on a number of variables, including the height and intensity of the light fixture, the type of bulb used and the wavelength of the light emitted. Streetlights, for example, have a typical maximum light level (at the surface directly under the fixture) of approximately 5 foot-candles, and floodlights on existing Sand Point buildings typically produce up to 3 foot-candles. With exceptions such as high-mast freeway lighting, the lighting levels from these fixtures typically diminish rather rapidly with lateral distance away from the fixture. The lighting level from the proposed sports field lights would decline to 1 foot-candle at a horizontal distance of 135 feet from the light source, and 0.2 foot-candle at a distance of about 205 feet. By comparison, the approximate lighting level for full moonlight is 0.02 foot-candle. Consequently, the small portion of the wetland/habitat complex that would receive spill light from the nearest sports fields would experience (during times when the lights were on) artificially-elevated lighting levels from the project that would be brighter than moonlight by a factor of 10 or more, but much less bright than areas close to nearby floodlights or streetlights.

The available research reports contradictory conclusions regarding whether and how artificial lights and specific lighting levels may affect natural environments. Some research has found that light in excess of and even below the level of full moonlight may alter behavior and the circadian rhythms of wildlife and plants (Health Council of the Netherlands 2000). Conversely, other studies have found that under laboratory conditions it takes very bright light to alter the biological rhythms of animals (Health Council of the Netherlands 2000). Consequently, it is not possible to apply the research results to identify a specific lighting level that corresponds to a demonstrated response by wildlife. Moreover, it is quite possible that a given species might respond to a given lighting level, but that response might not translate into a measurable effect on the health or persistence of the species.

Some of the available research indicates that the type of lighting fixture also appears to influence the potential effects of the light. Research on the effects of light of different wavelengths on wildlife has primarily been done in a laboratory setting rather than in the field (Wise, pers. comm.). Frogs are sensitive to lights, and most amphibians are attracted to blue light (Wise, pers. comm.). Many insects are more attracted to blue light than yellow light (Eisenbeis 2002; Frank 2002). A study in Germany showed that high-pressure sodium lamps, which emit yellow light, attracted 60 percent fewer insects than mercury vapor lamps, which emit blue-green light (Eisenbeis 2002). High-pressure sodium bulbs put out light in the yellow and red portions of the spectrum, which appears to be very attractive to migrating birds (Gauthreaux, Jr. and Belser 2002). Yellow lights also disrupt the homing ability of Eastern newts, causing them to become disoriented (Wise, pers. comm.).

Overall, the research implications relating to the light spectrum and the type of fixture are inconclusive. As noted, bright lights in the white/blue end of the spectrum may affect some amphibians and invertebrates, whereas the "warmer" sodium lights, with light in the yellow/red end of the spectrum, may attract migrating birds and perhaps some amphibians. In addition, this body of research to date has addressed the basic responses (attraction or avoidance) of wildlife to various types of light, but has apparently not extended that response information to conclusions about species behavior in the field and consequences for specific populations.

Luminaires proposed for use on the sports fields are 1000-watt metal-halide bulbs. These bulbs produce a bright, focused, white light in the blue and green portions of the light spectrum. High-pressure sodium lights produce more diffused light in the yellow and red portions of the spectrum, and are often used for streetlights. Low-pressure sodium lights do not produce bright enough light for sports field use

(Armstrong, pers. comm.). Some lighting engineers use a combination of metal-halide and high-pressure sodium lights, however, to produce a more natural, full spectrum of light.

Wildlife Behavior Responses

Some animals have been shown to alter their behavior during moonlit nights and in brightly lit areas. For example, bright lights have caused nocturnal amphibians and salamanders to stop foraging and reproductive activities for hours after the lights were turned off (Harder 2002). Other animals will avoid feeding in lighted areas to avoid predation (Longcore and Rich 2001; Harder 2002). Some predators will extend feeding into the night under artificial light, increasing predation risk to prey species (Longcore and Rich 2001).

Crepuscular animals (those that time their activity according to when dawn and dusk occur) inhabiting the site might experience a shortened night due to the proposed sports field lights (Wise, pers. comm.). For some frogs, salamanders, small mammals, birds, and reptiles, this could result in less time available for feeding and other activities. Without any screening such impacts could extend several hundred meters from the light source (Health Council of the Netherlands 2000); research does not identify how or if wildlife behavior might change if screening and shielding are used, or the specific type or configuration of lights associated with this conclusion.

There is some research on the effects of artificial light sources, such as street lamps and lights associated with tall structures, on birds. Studies have shown many species of birds are affected by artificial lights (for extensive reviews, see Trapp 1998 and Urban Wildlands Group 2001). In one study, birds were found to avoid nesting within several hundred meters of areas lighted by street lamps (Molenaar et al. 2000). However, no research was found on bird nesting impacts from sports field lights, which, unlike street lights, are not left on all night. Bright light beams, such as spotlights, were found to cause migrating birds to slow down and fly higher (Bruderer et al. 1999). Again, however, the proposed sports field lights would be focused into downward cones and/or would use full-cutoff or shielded fixtures to minimize glare and spill light; therefore, the research based on bright light beams may not be directly applicable. Birds that migrate nocturnally can be strongly attracted to lights (Verheijen, 1958, 1985) and, once inside a beam of light, become trapped because they are reluctant to fly out into the dark (Graber 1968). The most susceptible species include those that fly relatively low, such as warblers, thrushes, vireos, and other songbirds, raptors, and shorebirds (Cooper and Ritchie 1995).

Sports field and parking lot lights are not likely to have the same impact as TV towers or tall buildings, which have been shown to have adverse effect on migrating birds. Many cases of bird deaths due to collisions with lighted buildings and TV towers (up to 700 feet tall) have been documented (Avery 1980, Caldwell and Wallace 1966, Dinsmore et al. 1987, Grunbaum et al. 1998). Because little research has been done on the effects of light sources from relatively short shielded towers, such as those proposed for the sports fields, it is not possible to conclude the degree of potential adverse effect from the proposed lighting plan based on the research.

Many species of birds have been observed using artificial light to extend their feeding period into the night, including hummingbird, robin, kestrel, bittern, Scissor-tailed flycatcher (Imber 1975; Reed 1978; Goertz et. al. 1980; Frey 1993; Tryjanowski and Lorek 1998; Negro et al. 2000), and great blue heron (personal observation, Greenlake, Seattle, 2001). Extended feeding patterns may cause disruption to the biological day-night cycles of birds and greater feeding pressure on prey species.

Summary

As indicated above, the available research concerning the potential effects of artificial lighting on wildlife is inconclusive, and the results cannot be directly applied to the proposed sports field lighting systems. The documented studies indicating potential lighting effects on various wildlife guilds have focused on different types of artificial lighting systems, different lighting spectrums, different heights of lighting sources, and/or on lighting that has much longer daily duration than the proposed sports field lights. The research also includes some results with contradictory implications for the proposed project.

Because the existing research is inconclusive, it is not possible to predict *whether* the proposed sports field lights would trigger a response in local wildlife, and whether that response would result in adverse consequences. Regardless of whether such effects would occur, however, the physical characteristics of the project and the site can be assessed to support valid observations about the context and intensity of such impacts if they were to occur. Specifically, pertinent observations include:

1. *If* spill light from the sports field lighting systems did result in adverse effects for wildlife, the *extent* of that impact would be limited to a band approximately 200 to 300 feet wide along the western perimeter of the wetland/habitat complex. At distances much beyond that range, spill light from the sports fields would not be measurable. In addition, upland forest plantings are proposed for much of the perimeter area around the sports fields, including around most of the east and south sides of Fields 6 and 9, the southeastern corner of Field 10, the eastern side of Field 13 and the northern side of Field 15. These plantings are proposed to create a buffer for the habitat areas and would, over time, serve to screen or block some of the spill light that would otherwise escape to the wetland/habitat complex.
2. The *magnitude* of the lighting level within the western perimeter of the wetland/habitat complex would be low, exceeding 1 foot-candle only within a very limited area and generally ranging from 1 foot-candle to 0.2 foot-candle or less.
3. The *duration* of the artificial light presence within the perimeter habitat area would be limited to late-afternoon and evening hours (depending on the season) on a daily basis, but would not be continuous throughout all hours that are normally dark. Artificial light would be present within the subject area throughout the week and in all seasons of the year.

As described in the SEPA rules, evaluation of the significance of an impact involves consideration of the context and intensity of the impact (WAC 197-11-794). The rules note that the context may vary with the physical setting, that intensity depends on the magnitude and duration of an impact, and that the severity of an impact should be weighed along with the likelihood of its occurrence; an impact may be significant if its chance of occurrence is not great, but the resulting environmental impact would be severe if it occurred. In the present case, the observations about impact extent, magnitude and duration all point to a potential impact (adverse effects of the sports field lighting systems on wildlife using the wetland/habitat complex) of relatively limited intensity. With respect to context, a pertinent distinction is that the resource that might be affected by the proposed lighting systems is not now in existence; the proposed action is intended to provide a significant increase in the functions of the habitats found on the site. Therefore, if an adverse lighting impact were to occur, that impact would represent a marginally reduced increase in habitat function on the site, rather than a net loss of existing habitat function. Finally, while the likelihood of this impact is not known, it does not appear that the impact would be severe if it did occur.

The impact context can also be evaluated in more site-specific detail. In the proposed action, the Frog Pond wetland would be the closest breeding amphibian habitat to the field lighting systems, but this pond would lie outside the zone of spill light (this feature would be located more than 600 feet from the nearest lighted field) and the proposed lighting would not be detectable in this amphibian habitat. More generally, the area of the proposed wetland/habitat complex that would be subjected to light spill consists of the outer edge of the marshy flow-through pools. Those marshy pools do not now exist in that setting, and the existing habitat does not provide more than low-quality meadow habitat. Therefore, the issue of creating potential adverse impacts to wildlife habitat from sports field lighting could be avoided simply by not enhancing wetland habitat within the spill lighted zone of the fields. Instead, designing that perimeter area to be forested wetland would avoid potential adverse impacts to emergent marsh in a lighted fringe zone. Given the uncertain occurrence of those potential adverse effects, as indicated from the range of research available, DPR has instead elected to maintain the full original extent of the marshy pools. In view of the concern over the potential impacts, however, the proposal includes mitigating measures to reduce or eliminate light spill into the wetland area, monitor the habitats within the lit fringe compared to those in the unlit interior habitat zone, and initiate contingency actions if adverse affects are documented (see Section 3.4.1.5, below).

Potential Impacts to Specific Wildlife Types

Birds

Overall, birds are expected to increase in number and diversity with the changes anticipated under the proposed action. It should be stressed that bird abundance and diversity at the enhanced wetlands would not be expected to immediately match those of natural wetlands, but would increase as wetland vegetation became established (Brown and Smith 1998). The reduction in extent of meadow, savannah, and blackberry thicket would likely result in reduced numbers of ground-breeding and ground-dwelling birds (including Savannah sparrow, introduced ring-necked pheasant and California quail) and birds that forage and take cover in meadows and shrub thickets. The increase in wetland and upland habitat, in both area and diversity, is expected to provide new habitat for birds not currently using the park. Waterfowl species currently only observed in Lake Washington from the shoreline would be likely to inhabit the lagoon and the permanent open-water ponds, particularly in winter. Waterfowl might also breed at the interior edges of these ponds, which is now a rare occurrence (with the exception of the Canada goose, gadwall, and mallard).

The interior shallow mud-flat wetlands, with their soft substrate, are intended to provide habitat for benthic macroinvertebrates. This would in turn provide food for migrating and wintering shorebirds, including greater and lesser yellowlegs, semi-palmated plover, marbled godwit, long-billed curlew, and willet, and Virginia rails among others. Emergent wetlands would provide additional breeding and summer habitat for red-winged blackbirds, marsh wren, and common yellowthroat; emergent wetlands might provide habitat for secretive marsh birds not currently listed as occurring at the park, including the

American bittern and sorarail. Shallow foraging habitat for wading predators such as great blue heron, green heron, and the occasional egret would be more abundant. In addition to the wetland habitats, the proposed action would also result in an increase in native shrubs and forest on the site, linking the shoreline environment with the existing forests of Promontory Point. Forest-dependent birds such as woodpeckers, jays, crow, bushtit, warblers, and flycatchers might be predicted to increase in presence over time as the woody dominated habitats matured. Therefore, the proposed action is assumed likely to provide a broader range of habitat and fill niches for a broader range of bird species than the existing conditions.

The productive seasonally-flooded wetlands are expected to increase the invertebrate and plant productivity of the park overall. Invertebrates attracted to water, such as dragonflies, damselflies, caddis flies, mayflies, and midges would attract fly-catching birds (olive-sided flycatcher, Pacific-slope flycatcher, willow flycatcher, cedar waxwing, among others) that are now largely rare to uncommon (see the table of bird species provided in **Appendix C**). Other passerine birds might also be attracted to shrubs in and around the wetlands, which would likely attract a great number of insects and spiders for forage. Wetlands also provide a barrier to human and dog access, resulting in less disturbance of birds, particularly in the interior of the wetland complex.

As noted above, lighted sports fields associated with the proposed action might disorient migrating birds. Many species of birds have been observed using artificial light to extend their feeding period into the night (Imber 1975; Reed 1978; Goertz et al. 1980; Frey 1993; Tryjanowski and Lorek 1998; Negro et al. 2000) which could have unknown consequences on the availability of prey and effects on life history patterns. Light standards can also provide perches for predatory birds when other appropriate perches are missing, and documentation even exists of osprey utilizing athletic field light standards as nest locations when no other appropriate structures were readily available. It is proposed to provide perch/snag features within the interior of the wetland habitat zone in this part of the project site as a design element to demarcate the extent of the former runways on the site.

Mammals

The proposed action and lesser-capacity alternative are expected to have reduced area of upland habitats, increased area and types of wetland habitat, and therefore an increase in the structure and diversity of habitat availability for some wildlife species. There may be a net decrease in upland habitat and therefore a decrease in upland species (such as some prey species of mice and voles). However, the proposed action and lesser-capacity alternative are both expected to result in an increase in mammal diversity on the site.   Species expected to decline in abundance include the meadow vole, vagrant shrew, deer mouse, rat, rabbit, and other ground-dwelling mammals. Increased shrub cover could allow feral cats to become more abundant in the park, which could cause additional declines in meadow-dwelling small mammals.

The wetlands, with their increased structural complexity and species diversity, are expected to provide more habitat for beaver, muskrat and river otter, all present and common in the Lake Washington system. Beaver would likely take advantage of woody browse along the margins of the lagoon and interior wetland habitats, while muskrat would focus habitat use within the freshwater marshes and open permanent ponds of the interior. Nutria, an introduced aquatic mammal, could migrate to the park from the lake, potentially damaging the earthen berms separating wetlands with its large burrows. Moisture-loving shrews and moles might increase in abundance, providing additional forage for raptors and other predators. Raccoons would likely find new amphibian and invertebrate forage at the wetlands. Insect-eating bats are expected to increase in abundance as forests grow more mature and roosting habitat improves, and as insect abundance increases with additional wetland habitat.

Assuming meadow voles and mice are currently at maximum density in the park, the reduction of meadow and savannah habitat is expected to cause these species to decline in abundance. Rats, rabbits, and other ground-dwelling animals that prefer upland meadows, and do not favor forested areas are also expected to decline. Eastern gray squirrels, Douglas squirrels, and mountain beaver, if present, are expected to increase slightly as forests mature and native trees and shrubs increase. Mammals that are not present (other than some aquatic species) are not expected to colonize the site because the park is isolated from other natural areas.

The proposed action would provide a large interior wetland/upland habitat complex with limited human access. Placement of brush piles in upland buffers and large woody debris and snags in both upland and wetland habitat would benefit many small mammals, and cavity nesting species such as raccoons. Sports field and parking lot lights associated with the proposed action can be expected to attract insects and bats from surrounding areas. Bat populations are expected to increase slightly with this new food source (Reihle 1998).

Amphibians and Reptiles

Amphibian and reptile species are expected to increase in both diversity and abundance with the proposed action and the lesser-capacity alternative. Increases would be due to the increase in wetland habitat area, wetland diversity, and increased habitat structure created by habitat succession, brush piles, and down logs. Sports fields and parking lots would replace some existing snake and lizard habitat at abandoned buildings; these species, if present, might not recover if other structural features were not provided in the immediate vicinity. It is proposed to install rock piles along the southern sides of the upland landscape berms within the habitat area, to create reptile habitat. In addition, brush piles and dead trees (standing and downed) are proposed throughout the habitat area in wetland and upland forest settings. Pond-breeding amphibians that manage to colonize the new wetlands are expected to thrive with the abundance of food, cover and breeding sites. Species not known to breed at the site, including the Northwestern salamander, Northern red-legged frog, rough-skinned newt, and long-toed salamander might colonize via the shoreline of Lake Washington. Turtles are also likely to colonize the lagoon and permanent wetlands from other sites along Lake Washington. The introduced bullfrog might be expected to colonize the project site through dispersal from the wild. If not, experience indicates that well-meaning park visitors might transplant bullfrogs to the site. Other non-native species of amphibians, fish and turtles might be brought in and released, and these could have detrimental impacts on native species.

Sports field lights associated with the proposed action might extend the daily feeding periods of wading birds in shallow wetlands adjacent to the sports fields; if so, this would result in higher predation of amphibians. Amphibians and reptiles might alter their behavior to avoid lighted areas at night to avoid being eaten by visual feeders such as wading birds (Reed 1978). They also may curtail calling activity during the early evening hours of the spring breeding season when lights are on, potentially avoiding breeding in habitat near lighted areas (Buchanan 1993).

3.4.1.3 Wildlife Impacts of the Alternatives

Lesser-Capacity Alternative

The lesser-capacity alternative has a substantially different artificial-turf field configuration than the proposed action, fewer new parking lots on the west side of the park, and fewer illuminated fields. For the lesser-capacity alternative, the existing tennis courts and associated interior road and parking lot would be retained, allowing continued access to the interior of the proposed habitat area. Proposed increases in wetland habitat type and complexity would provide greater habitat diversity than existing conditions, as even the reduced field configuration would result in increased water (relative to existing conditions) directed into the interior habitat areas. The revised configuration of the lesser-capacity alternative includes only 3 lighted fields, compared to 11 for the proposed action. Therefore, the number of expected night park visitors would be significantly reduced, as would any issues associated with the influence of artificial lighting on wildlife. The revised configuration also eliminates one Little League baseball field (Field 9), resulting in the retention of a greater area of existing wet meadow vegetation.

The creation of new seasonally-flooded wetlands even in the lesser-capacity alternative is expected to increase the diversity and abundance of wildlife using Sand Point Magnuson Park because of the high productivity of such wetlands. The seasonal inundation by water and drying ensures that minerals become oxidized each year and remain in circulation, producing a much greater quantity of plant and invertebrate biomass than uplands or permanently flooded wetlands over the same area. Permanently ponded wetlands would provide a range of habitat for invertebrates and amphibians as well that is not present in existing conditions.

The lesser-capacity alternative might not increase the abundance or diversity of wildlife species sensitive to human activity as much as the proposed action, due to the retention of the access road through the interior of the proposed wetland complex. Greater access by foot traffic into the expanded wetland, meadow and savannah habitats (because of the continued presence of the interior roadway and parking lot) would reduce the benefits for more reclusive species, relative to the proposed action. Human access to the interiors of the habitat zones would result in disturbance of resting, foraging, and breeding birds, and even potentially cause nesting failures.

No Action Alternative

Under the no action alternative, wildlife habitat at the park would change over time through implementation of the Vegetation Management Plan for Sand Point Magnuson Park (City of Seattle, 2001), and by natural succession. A key component to the plan is removal on non-native vegetation such as Himalayan blackberry and hawthorne thickets. Removal would occur in phases and thickets would, in most cases, be replaced with native shrubs. Savannah, wetland, and forest habitats would continue to mature, although no new wetland habitats would be created. Meadow area would decrease through replacement by woody shrubs and trees as the wet and dry meadow and savannah habitats progress through anticipated vegetation community succession. Shallowly-ponded wetlands such as Frog Pond would eventually succumb to succession, in time becoming dominated by woody shrubs and trees that would eliminate breeding habitats for amphibians and invertebrates. Deciduous forest would likely become a more common component of the park as existing saplings mature and existing trees reproduced. Wetlands that are currently dominated by sapling cottonwood and willow would become forested wetlands, and the wetlands would likely dry earlier in the season due to increased rates of tree transpiration. Deciduous trees and native shrubs are expected to be larger and form denser thickets, improving their function for cover and forage for wildlife, particularly passerine birds. Forested habitat at Promontory Point would remain intact, with assumed continued efforts to control invasive species such as clematis and English ivy, and install native conifers. Expected changes in habitat and population conditions for key species groups under this scenario are summarized below.

Birds

Bird use patterns in Sand Point Magnuson Park are expected to change over the next 25 years as a result of implementation of the Vegetation Management Plan and natural succession over the next 25 years. Birds that use meadow habitats exclusively, including the Savannah sparrow, black swift, and common snipe, are expected to decline slightly in numbers due to replacement of open meadow with woody vegetation. However, the number of bird species that would benefit from the increasingly diverse, larger and denser native shrub and forest habitats is expected to offset these declines. Migrating warblers and other passerines would be expected to benefit from the additional insects, fruits and nuts provided by the mature woody vegetation. Passerine and ground-dwelling birds that use meadow habitat would diminish in presence while shrub and savannah habitat adapted species are expected to benefit from the increased cover, nesting, and forage habitat provided by larger and more mature vegetation.

Based on the recommendations of the VMP, blackberry thickets would be removed sequentially so resident and migrant passerine birds would not dramatically decline until native vegetation can become established. The phased, limited nature of the planned blackberry removal would limit the extent of the impact. Sequential removal and restoration is proposed, but it is not clear how long it would take planted native shrubs to provide similar habitat quality. The adopted VMP is clear in its directive for the timing of non-native vegetation removal to avoid prime bird breeding seasons. In addition, the VMP provides guidance on the seasonality for mowing and maintaining meadows to avoid nesting birds, and guidance as to when to mow lawn and turn areas in the spring to reduce the opportunity for ground nesting birds to use inappropriate sites for nesting.

Mammals

The increase in forest area would provide additional habitat for medium-sized mammals that may already be present, such as the Eastern gray squirrel, opossum, raccoon, and mountain beaver. This alternative would provide no additional habitat for aquatic mammals such as river otter, beaver, nutria, and muskrat other than the increase in size of willows along the shoreline. Reductions in numbers of small mammals that use meadow habitats is expected, with an increase in species in shrub thickets and forests. Species expected to decline in abundance include the meadow vole, vagrant shrew, deer mouse, rat, rabbit, and other ground-dwelling mammals. The declines are not expected to be as dramatic as with the proposed action and the lesser-capacity alternative. Increased shrub cover could allow feral cats to become more abundant in the park, which could cause additional declines in meadow-dwelling small mammals.

Amphibians and Reptiles

With natural succession and the implementation of the park's Vegetation Management Plan, terrestrial amphibian habitat is expected to improve while habitat for pond-breeding amphibians declines. As forests matured, dead and down material would provide more winter and summer foraging and cover habitat for non-breeding and terrestrial amphibians. Specifically, terrestrial amphibians such as Ensatina and Western red-backed salamander might increase, while long-toed salamanders and Pacific treefrogs might decline due to loss of suitable breeding habitat as ponds become shaded and dry earlier in the summer. Opportunities for the introduced bullfrog to colonize the park are not expected to increase as wetlands become tree dominated over time.

Future conditions for reptiles will depend largely on the current population status (which is unknown) and minor habitat changes and impacts from domestic animals and other predators. The majority of habitat alterations would not directly impact reptiles in the proposed project area. Piling brush around the park following vegetation removal and maintenance as directed by the VMP would provide additional cover and basking areas for snakes and lizards. Habitat would not be modified significantly enough to alter habitat for turtles.

3.4.1.4 Cumulative Wildlife Impacts

Urban and agricultural development around the shores of Lake Washington, in the City of Seattle, and within the surrounding region has created long-term loss of natural vegetation and the wildlife habitat it supported, representing significant adverse cumulative impacts to wildlife habitat. Implementation of the proposed action would result in a net increase in the acreage of upland and wetland plant communities with desired natural characteristics on the project site, and a corresponding increase in the value and diversity of wildlife habitat on the site. This increase would run counter to the long-term trend of diminished wildlife habitat in the local area and the surrounding region. At a more localized scale, the proposed project would restore a substantial portion of the historical wetland and upland habitats that once existed on the Sand Point peninsula. Therefore, with respect to physical changes to functioning ecological communities and wildlife habitats, the proposed action does not have the potential for adverse cumulative impacts.

Creation of new sports fields and the establishment of formal educational uses in the wetland/habitat complex would likely increase the public awareness of the expanded habitat areas within the park and increase the numbers of park users. For some species of wildlife this increase in human presence could be a deterrent to their use of the site; however, those species would not be attracted to use the site without the proposed increase and diversification of habitat types proposed with either action alternative. Proposed changes in the existing conditions of the Off-Leash Area (along the trail and at the water access) would result in a net benefit for habitat function in immediately adjacent areas. Stabilization of the beach in the Off-Leash Area would benefit aquatic-based species south along the shoreline to the proposed lagoon. The new continuous perimeter fencing surrounding the permanent Off-Leash Area would decrease the random entrance of dogs into the habitat area by jumping over the past sagging temporary fencing. The presence of some dogs off-leash outside of the official Off-Leash Area in the habitat zones would continue in any alternative, including the no action alternative, as is the case in all parks.

Additional shoreline restoration work proposed for the North Shore Recreation Area might provide additional forage for beaver. If so, habitats within the interior of the project site could become utilized by breeding populations. Such urban re-settlement of beaver has occurred within the last 5 years at Meadowbrook Pond on Thornton Creek, from beaver moving up the creek from Lake Washington.

3.4.1.5 Wildlife Mitigation Measures

A primary purpose of the proposed project is to provide a significant increase in the functions of the upland and wetland habitats on the site. An extensive set of specific actions intended to restore former habitat, enhance existing habitat or create new habitat, and to protect the functions of those habitats in operation, is included in the proposed project. Those actions are described in detail in Chapter 2 of the EIS, primarily in **Section 2.2.5**. Some of the specific habitat-related actions included in the proposal would effectively represent mitigation for existing habitat displaced by developed park uses, while others would appropriately be considered enhancement of existing habitats. To provide a complete summary of proposed mitigation, all applicable features of the habitat design are discussed below. A subsequent discussion of potential mitigation related to concerns over the possible effects of artificial lighting is also included.

Habitat Design

For both action alternatives, it is proposed to provide physical complexity to the habitats on site through the installation of brush piles, placement of large woody debris in upland and wetland habitats, and placement of snags and perches throughout the site. Even in the no action alternative, the recently adopted Vegetation Management Plan calls for the placement of brush and large woody debris culled from the removal of invasive species such as Lombardy poplars throughout the habitat zones within the park. The VMP identifies appropriate methods of using poplar debris to form habitat elements. Within the open-water ponds and along their margins, large woody debris would be placed for haul outs for waterfowl and turtles, as surfaces for egg masses, and as a source for large organic surfaces for detritivores to inhabit.

In addition, in the proposed action and lesser-capacity alternative it is proposed to place design elements along the perimeter of the former airstrips to denote the historical presence of the landing strips. These elements would be designed to provide perch sites and nesting opportunities for small to large raptors and /or owls. Where appropriate, standing Lombardy poplars can be converted to snags by complete girdling, and careful control of stump and root sprouting. Choosing locations that are far from pedestrian and/or vehicular access would be critical. Creating chip mulch piles in some habitat locations would facilitate decomposition, fungal and bacteria development and subsequent soil health more rapidly.

The linear landscape design berms scattered along the western and northern limits of the habitat area would be constructed with large to small boulder caches and piles along their flanks to provide for reptile, mammal and amphibian habitat niches. The rock faces would provide sunning and observation perches, as well as refuge from predators.

Physically eliminating aquatic linkages between the lagoon and open-water habitats of the interior, while allowing water to flow through leaky berms into the lagoon from the wetlands, is designed as a compensation element. Export of dissolved organics into the lagoon and lake is important for linking aquatic food chains. Limiting easy access for invasive predatory fish and amphibians into the interior habitats would prolong the benefits there for native species.

Anticipating extensive herbivory on soft-stemmed and woody wetland and buffer species, and over-planting willows and cottonwoods initially to assure adequate food supply would allow beaver to freely feed while not jeopardizing attainment of performance standards for the lagoon revegetation. Temporary fencing may have to be placed to protect herbaceous species and some woody species (especially existing older black cottonwood trees) until newly installed specimen reach sufficient size to be able to withstand annual grazing by beaver or muskrat.

Temporary, and if necessary, permanent innocuous fencing would be placed at strategic locations around the perimeter of the interior portions of the habitat zones to preclude inappropriate access. Fencing would be placed at the time of initial habitat planting and installation to assure protection of plants, exclusion of inappropriate access and protection of establishing wildlife populations. As vegetation matured, fence removal would be dependent upon use patterns of humans and wildlife populations, and observations/responses by park users. Wildlife habitat would be significantly enhanced in the park due to mitigation measures including the addition of brush piles, downed logs, and snags. Animals currently present in the park in limited numbers due to lack of habitat could be expected to increase in abundance. Wildlife that might benefit from such habitat enhancements include mice, voles, shrews, snakes, frogs, salamanders, songbirds including sparrows and wrens, and the animals that eat them, including raptors, great blue heron, and raccoons. Turning invasive woody trees such as Lombardy poplars into standing snags would provide feeding and nesting habitat for birds, including woodpeckers, chickadees, swallows, European starlings and house sparrows. Snags could also provide new perching habitat for crows, red-tailed hawks, bald eagles, and other raptors.

Monitoring of future conditions on the site would be a key component of the proposed project. A variety of monitoring activities would be conducted as a comprehensive program to track the success of the wetland/habitat complex. Specific monitoring objectives would be to determine the rate of progress of habitat development/enhancement over time, establishment success for specific habitat types, species use of the respective habitats, species diversity and numbers, and control of human disturbance factors.

Mitigation for Lighting Effects

Several options exist for mitigating potential lighting effects on wildlife habitat. Options include lighting and field configuration changes, lighting design changes to provide more screening, structural screening measures, lighting operational changes , and modifications to the planned configuration of the wetland/habitat complex. These options are discussed further below.

- Lighting and field configuration changes. Plans for the lighted sports fields could be modified to remove or reduce the amount of sports field lighting near the habitat areas. Under the proposed action the perimeters of Fields 6, 9 and 10 would be essentially adjacent (beyond a narrow buffer) to the western edge of the wetland/habitat complex, while corners of Fields 13 and 15 would be within about 100 feet of the wetland/habitat complex. Eliminating light systems from Fields 6, 9 and 10 would create an unlighted buffer between the remaining lit fields and the habitat areas of 200 to 300 feet. Eliminating lighting from fields directly adjacent to the habitat areas area would eliminate spill light into the habitat areas from those fields, but would not change light spilling from other fields located further away (Armstrong, pers. comm.), such as Fields 5 and 8. Another possible way to remove lighting from sensitive habitat areas would be to lower the light poles, as lower light poles keep the light in a smaller area (Longcore, pers. comm.; Armstrong, pers. comm.).

- Lighting design changes. Direct glare from luminaires in shielded conventional flood lights (as proposed for use on Fields 7 and 8) can be seen from a distance of two times the mounting height at the elevation of the sports fields (Armstrong, pers. comm.). Conventional shielded floodlights on the western side of these fields would cast some glare directly into the wetland area as a result of their aiming angle. Taller light poles with a narrower light beam pattern and/or a higher aiming angle could be used to reduce the amount of light escaping from these fields, although this measure would represent an aesthetic tradeoff because the taller poles would be more visible. Alternatively, use of full-cutoff fixtures on these fields would reduce the illumination and glare produced beyond the targeted lighting area of the field.

- Structural screening measures. Some of the light directed toward the habitat area could be screened using mounds and tall trees and shrubs between the habitat area and the sports fields. The benefits of such screening at the immediate edge of the habitat area would be little until the trees grew as high as the light poles and, given the assumed year-round use of the sports fields, coniferous trees would be the only effective year-round screen. Mounds and trees would shield some of the habitats from sports field lighting, making the habitats nearest the fields usable for those species less sensitive to lighting and human presence

- Lighting operational changes. The sports field lights would always be turned off when not in use, as discussed in **Section 2.2.**9. Beyond that, the proposed hours of light system operation could be reduced to minimize the number of days when artificial light would be experienced in the habitat areas nearest the sports fields. Examples of such measures include a lighting curfew set for a certain time each night (such as 10 or 11 p.m.); a limit on the number of days per season or per year that the light systems closest to the wetland/habitat complex could be operated; or a variable limit on the number of operating hours year-round, to more closely approximate natural seasonal light and dark cycles.

- Wetland/habitat reconfiguration. The zone of the wetland/habitat complex that would be within the fringe of light spill from the fields could be changed in the project design from marshy pool habitat to wetland forest. This would reduce the potential for lighting effects to amphibian and aquatic species by eliminating the proposed marshy pool habitat, and increasing the forested fringe between the sports fields and the aquatic habitats to the east would thereby increase shielding for the other aquatic habitats over time.

3.4.1.6 Significant Unavoidable Adverse Wildlife Impacts

The total habitat area within the project site would be enlarged over that which currently exists, resulting in an overall increase of 11 acres of effective habitat area. Development of sports fields within the existing habitat zones of Sand Point Magnuson Park would reduce those existing habitats by 11.4 acres, but that decrease would be more than offset by habitat expansion and improvements elsewhere within the project site. The proposed action would also provide increased habitat diversity and structural complexity, and greater duration and depth of inundation in the proposed wetlands. Therefore, the proposed action would result in positive (rather than adverse) direct impacts on the extent and quality of wildlife habitat.

The proposed action or the lesser-capacity alternative would both result in many more visitors to Sand Point Magnuson Park. The park is designed and prioritized for public use and enjoyment, and the proposed action and lesser-capacity alternative both include measures to minimize human disturbance effects on wildlife habitat. The increased human use could possibly be detrimental to species of wildlife that are sensitive to humans and/or domestic animals, however. Even in the no action alternative, one should assume that simple demographics would lead to increased human use over time as population pressures mount.

3.4.2 <u>Fish</u>

3.4.2.1 Affected Environment

<u>Historic Conditions</u>

The following information has primarily been taken from "Seattle's Aquatic Environments" by Keith Kurko (2001), which relied heavily on the "Lake Washington Subarea Chapter" by Kurt Fresh in the *Draft Reconnaissance Assessment – Habitat Factors that Contribute to the Decline of Salmonids* by the Greater Lake Washington Technical Committee (2001).

Prior to 1916, the elevation of Lake Washington was approximately 32 feet and the natural outlet was the Black River on the southern shoreline. The typical hydrology consisted of a lower lake elevation during the summer and a higher level in the winter, with a maximum change of 6.5 feet in any year. In 1916, the Lake Washington Ship Canal and Hiram M. Chittenden Locks were opened, the lake level was dropped approximately 10 feet to 22 feet in elevation, and the outlet to the Black River was blocked. The decrease in elevation exposed approximately 3.2 square miles of previously shallow-water habitat, reduced the lake's surface area by 7.0 percent and eliminated much of the lake's wetlands. The Cedar River, which formerly flowed into the Black River, was diverted to flow into the lake at the southeast corner to provide sufficient water flow through Lake Washington. Also, the hydrology of the lake was reversed such that summer water levels were approximately 2 feet higher than winter levels, with the lake acting as a reservoir for lock operation.

With increasing urbanization, the shoreline of Lake Washington has been extensively altered. The majority of the shoreline is now urban-residential with the exception of a few commercial and industrial developments. Seattle and 12 other cities now border the lake. The lake has approximately 80 miles of shoreline, including the shoreline on Mercer Island. Lakefront parks maintained by Seattle and other jurisdictions provide the only substantial exception to this highly developed shoreline condition. Seattle's city park shorelines are relatively undeveloped, although riparian vegetation is often absent.

As the watershed has developed, dredging, filling, and the construction of piers, docks, and floats have occurred in shoreline areas. Shorelines have been bulkheaded, rip-rapped, or hardened with concrete rubble or treated wood; substrates consist of mixed gravels, sands, and debris. Over 2,700 docks surround the lake, consisting mostly of single-family residential docks with a few marinas (Toft 2001). The shoreline geomorphology is almost all moderate or low gradient, with few areas of emergent marsh and stream delta habitats (Toft 2001). The upland cover directly above the shoreline is mostly garden/lawn, with under 20 percent of natural scrub/shrub, forested, or herbaceous habitat. Much of the large woody debris that was likely associated with the lake's shore has been removed (Kurko 2001).

Existing Conditions

There is no existing fish habitat within Sand Point Magnuson Park, with the exception of the shoreline of Lake Washington. In current conditions, the shoreline in the park is approximately 2,000 feet long. For nearly its entire length that shoreline is armored with asphalt and/or concrete rubble or debris. In some locations poured walls are in place, in other locations, debris has been piled and stacked to form bulkheads. In addition there is concrete and asphalt rubble on the lake bottom for up to 30 feet distant from the shore in some places. No surface water connection from the lake into the interior of the park has existed since Mud Lake was filled in the early 1900s.

The proposed lagoon development area is located immediately north of the existing boat launch. The shoreline in this location is bulkheaded and rip-rapped with concrete rubble. Native and non-native vegetation is found along the shoreline, with over 50 percent of plant cover consisting of Himalayan blackberry and weeping willow. A few tall trees are located just north of the boat launch; they provide some afternoon shade to the immediate shoreline in the vicinity of the proposed lagoon.

The limnological characteristics of Lake Washington have undergone dramatic changes during the last 50 years. The lake received direct discharges of secondary treated sewage effluent from 1941 to 1963. The phosphorus additions greatly increased blue-green algal production. Since 1968, phosphorus has decreased with the diversion of sewage effluent, but alkalinity and surface water temperatures have increased.

Eurasian watermilfoil has colonized a large percentage of the littoral zone since the 1970s and replaced much of the native aquatic vegetation. Milfoil has altered the physical characteristics of littoral zone habitats by changing substrate characteristics and decreasing levels of dissolved oxygen.

Shoreline areas may receive contamination from leaching of polyaromatic hydrocarbons (PAHs) and heavy metals from treated wood. Piers shade the water and reduce phytoplankton production. Summer boating traffic, combined with the effects of high water levels and bulkheads, contributes to a high level of wave activity and substrate disturbance.

Existing Fish Use of Lake Washington Shorelines

Native fish known to use the shoreline habitats of Lake Washington are identified in **Table 3.4-3**. Cutthroat trout, rainbow trout, and bull trout/Dolly Varden are found in Lake Washington during rearing phases of their life history, although spawning and egg development occur in cool-water streams (Wydoski and Whitney 1979). Northern squawfish, longfin smelt, threespine stickleback, peamouth, and sculpins are also native to Lake Washington (Wydoski and Whitney 1979). Northern squawfish are found in shallows with sand or mud bottoms where water temperatures are warm; adults feed on sculpins and other small fish. Longfin smelt are usually found in open water, preferring deeper water during the day and migrating upwards at night. Stickleback are associated with aquatic vegetation and are found at the bottom of the lake; peamouth prefer warm water areas in Lake Washington, and move from deep water in winter to inshore areas during spring and summer.

Table 3.4-3
Fish Species Expected and Observed under Existing Conditions

Species	Scientific Name
Cutthroat trout	*Oncorhynchus clarki clarki*
Rainbow trout	*Oncorhynchus mykiss*
Bull trout/Dolly Varden	*Salvelinus confluentus*
Northern squawfish	*Ptychocheilus oregonensis*
Longfin smelt	*Spirinchus thaleichthys*
Threespine stickleback	*Gasterosteus aculeatus*
Peamouth	*Mylocheilus caurinus*
Sculpins	*Cottus* spp.
Sockeye salmon	*Oncorhynchus nerka*
Coho salmon	*Oncorhynchus kisutch*
Chinook salmon	*Oncorhynchus tshawytscha*

Salmonid fry rearing in the lake and salmonid smolts migrating through the lake prefer shallow shoreline areas with sandy beaches (City of Bellevue 2001). Based on research done on salmon fry at the south end of Lake Washington (coming in from the Cedar River), small fry tend to stay in quite close in the shallows of the lake margin in order to avoid predators. When quite small, they are not a preferred food source for heron, kingfisher or other near-shore predators, but are preyed upon more by larger fish, which do not come into the shallows. As the fry increase in size, they tend to move into deeper water where they more readily avoid predators in the shallows (Tabor, personal communication). Sockeye salmon fry move into the lake shortly after emergence and spend at least one year rearing in the lake. Coho salmon migrate through the lake as fry. Chinook salmon usage and life history are discussed below since they are a “threatened” species in the Puget Sound area under the Endangered Species Act.

Anadromous fish that would be in the vicinity of the proposed lagoon would be coming out of the Sammamish system at the north end of Lake Washington and moving south toward the Ship Canal. Salmonid fry in the Sammamish system tend to stay in that system longer than in the Cedar River system, meaning that fry coming into Lake Washington at the north end tend to be larger (older) than the fry entering from the Cedar. The larger fry tend to move slightly more off-shore than the younger smaller fry, so it is unknown how they might use a created lagoon habitat (R. Tabor, personal communication). Unlike riparian habitats, where large woody debris and rocks provide the habitat complexity that research has shown to be beneficial to anadromous fry, the lake shore habitat configurations may need to be less cluttered (Kurko, 2001). Logs and other woody debris along the lakeshore provide habitat niches to species such as bass (and in some instances provide habitat for crayfish, a preferred prey of bass) which can feed on young fish. Rocky crevices (from rip rap or boulders) can provide habitat for crayfish, which can prey on young fish. Therefore, structural complexity within the water column may not be the most advantageous for anadromous fry.

It was noted by Tabor, during a field visit in December 2001, that some areas of the shoreline provide adequate substrate conditions in existing conditions, south of the proposed lagoon, near the southern limits of the Park. The area is completely bulk-headed, however, the lower lake levels in the winter shift the waters edge away from the rubble wall so that wave wash occurs over small to modest sized gravels (the higher summer water level creates standing water at the face of the wall). Juvenile fish moving south in the lake in late spring would be sufficiently offshore that they would be in an area of appropriate substrate size.

In addition to native fish, several non-native fish species have been introduced to the Lake Washington system, including largemouth and smallmouth bass, black crappie, yellow perch, sunfish, and brown bullhead (Li 1998). The distribution of smallmouth and largemouth bass in shallow areas overlaps that of chinook juveniles; they are both present between April and June (City of Bellevue, 2001). Largemouth bass prefer warm water and shallow, weedy areas with mud, sand or organic substrates, while smallmouth bass are commonly found over rocky substrates where some current is present (Wydoski and Whitney 1979). The majority of known bass predation on juvenile salmonids occurs in the Ship Canal (City of Bellevue, 2001). Bass are oriented to structures for both spawning and foraging, and will utilize artificial structures such as rock piles for nest sites. Twenty-three non-native fish species are currently in the lake; some are known to prey on juvenile salmon (e.g., largemouth bass) while others are potential competitors for food. **Table 3.4-4** identifies non-native fish known to use the shoreline habitats.

Table 3.4-4
Non-Native Fish Species Expected and Observed under Existing Conditions

Species	Scientific Name
Largemouth bass	*Micropterus salmoides*
Smallmouth bass	*Micropterus dolomieui*
Black crappie	*Pomoxis nigromaculatus*
Yellow perch	*Perca flavescens*
Sunfish	*Lepomis* spp.
Brown bullhead	*Ictalurus nebulosus*

3.4.2.2 Fish Impacts of the Alternatives

Proposed Action and Lesser-Capacity Alternative

Both the proposed action and lesser-capacity alternative include creation of a 4.4-acre lagoon along the shoreline of Lake Washington, in the approximate location of the former outlet of Mud Lake. The lagoon, shown in **Figure 2.2-1**, would add approximately 5,180 linear feet of new shoreline to Lake Washington. The objectives for the lagoon are to:

- eliminate an existing length of rip-rapped shoreline on the lake and to create extensive heterogeneous shoreline conditions for various aquatic species;
- create an area that provides secluded habitat for waterfowl and other wetland associated birds;
- create overhanging woody vegetation and woody browse within riparian habitats for aquatic mammals and other species;
- create a convoluted shoreline to maximize shoreline length and provide the opportunity for adequate shading to allow regulation of water temperatures; and

- create the opportunity for export of biomass into the near shore environments of the lake.

It is expected that this lagoon would provide habitat for a variety of native fish found in Lake Washington, while assuring that no increased risk to the survivability of federally or state listed species occurs (K. Kurko and R. Tabor, personal communications). At the northern end of Lake Washington, Puget Sound chinook salmon most often enter the lake system in April after spending an extended time in the Sammamish River watershed. As slightly larger juveniles, these fish tend to move towards the outlet of the lake in slightly deeper water conditions than the much smaller fry which enter the Lake Washington system from the Cedar River watershed to the south. The larger juveniles tend to hold and move slightly off-shore, to avoid the predatory birds towards land and the predatory fish in deeper habitats. (R. Tabor, personal communication, December 2001). It is unknown if these fish would utilize the lagoon because there is so little data on young salmonids in northern lake Washington, although there is no reason to consider that the lagoon would prove a detriment to native salmon fry (R.Tabor, personal communication, December 2001). Other native fish such as fat-scale sculpin would use the lagoon readily, and thereby provide additional prey source for predatory fish within the lake.

Water temperature is a typical concern relative to fish habitat, and there is some risk that water within the lagoon would be warmed from sunlight. The lagoon design includes five key features to address that potential impact. The size of the lagoon has purposefully been kept relatively small to reduce the surface area subject to thermal heating. The lagoon has been designed to maintain a deep (greater than 4 feet) open-water connection to Lake Washington during the summer months, when water temperatures are highest. The open-water connection would allow relatively cooler water from the lake to circulate into the lagoon. The interior lagoon would be over-excavated to approximately 13 feet in depth to assure a year-round connection to the groundwater present in that area, providing a cool groundwater flow source into the lagoon in the summer months. In addition, the outer lagoon is designed to act as a passive sediment trap, entrapping water-borne sediment entering into the lagoon opening from the open water of the lake, thereby reducing the amount of water-borne sediment that would accumulate in the inner lagoon. Finally, existing trees along the southern edge of the lagoon would be retained as much as possible (**Section 2.2.5**), and a mixed deciduous/coniferous forest would surround the entire southern and western margins and fingers of the lagoon. This is intended to surround the lagoon on the south, west and north sides with a convoluted woodland mosaic, in an effort to provide the maximum amount of shade as quickly as possible over the water’s surface. Although it would take several decades for the coniferous and deciduous trees to attain heights greater than 40 feet, shading of the shallow near-shore habitats in the lagoon would be provided in a much shorter time frame. These design features are expected to maintain water in the lagoon at relatively cooler temperatures that are more suitable to the habitat needs of native fish, and that are not preferred by non-native predatory fish, such as large-mouthed bass.

Some review comments on the Draft EIS expressed concern over postulated adverse effects of operation of the proposed lighting systems on fish using the lagoon habitat. Based on the substantial distance separation between the sports fields and the lagoon area (approximately 1,000 feet or more) and the upland forest communities that would be developed around the lagoon area and in the buffer area to the east of the sports fields, there would be no measurable increase in lighting levels above the fish habitat created by the proposed project. Consequently, there is no basis to assume any adverse lighting impacts from the project on fish.

<u>No Action Alternative</u>

If the proposed project were not implemented, the shoreline of the lake within the park would slowly be restored according to the provisions of the Vegetation Management Plan. The VMP calls for the existing shoreline armoring to be removed, for non-native plant species to be replaced with native woody species and, where feasible (outside of high human use zones), for native riparian and aquatic vegetation to be re-established within and along the shoreline in clusters focused where existing pockets of native vegetation are present. The reality of park management priorities and budgeting constraints is that such actions would occur gradually over the long term.

3.4.2.3 Cumulative Fish Impacts

Three other projects are under consideration for Sand Point Magnuson Park that may contribute to a net benefit to fish habitat along the lake shorelines of the Park. The North Shore Recreation Area project to create a small non-motorized watercraft launching facility is currently in the preliminary design phase. This project is considering removing a portion of the extensive bulkheading that was placed at the time Pontiac Bay was filled in the early 1900s, and replacing it with a more gently sloping and vegetated shoreline. The project plans are still in the early conceptual stages so no final plans have been developed, but project planning is taking into account restoration of native shoreline habitat.

A second design idea is under consideration in the dog Off-Leash Area (OLA), immediately along the shoreline. This is an area of concentrated dog use, year-round, with active dogs in and out of the water through the near-shore environments. Design concepts for this area of the OLA have discussed reshaping and stabilizing the shoreline by creating a gradual beach slope with a thick blanket of gravels as substrate. The goals of the redesign for this shoreline area are to reduce sediment movement into the lake and provide a more stable beach substrate for humans and dogs.

Plans are also in development for major maintenance improvements to the Magnuson Boat Launch (see **Section 2.6.7**). The improvements would include replacement of the deck surface of the existing launch piers with a more habitat-friendly grated surface near the shore.

These three shoreline concepts within the park would result in a net benefit for fish and other aquatic species. Reduction in sediment inputs to the water, increase in native riparian and overhanging vegetation, and elimination of some of the shoreline bulkheading would all be positive acts towards restoring some natural shoreline integrity to the lake margin in the park.

The proposed lagoon would result in the creation of more than 11,000 linear feet of new shoreline and provide additional fish habitat in an area that is currently upland grassland and meadow. There is no anticipated cumulative adverse impact associated with this concept.

3.4.2.4 Fish Mitigation Measures

Because no fish habitat occurs on site, no on-site adverse impacts to fish habitat are expected. In anticipation of any adverse effect on water quality from runoff generated from on-site roads and parking, all stormwater generated from the proposed project area would be directed through a series of treatment trains to provide for water quality improvement prior to the stormwater being discharged to the created wetland complexes and then through the lagoon into the lake.

Removal of the shoreline rip-rap in the area of the lagoon would benefit native fish by reducing crawfish habitat, reducing the erosive power on wave action on the small unprotected portions of shoreline, and allow for the re-establishment of native riparian vegetation.

In the proposed lagoon, shoreline substrates and riparian conditions would be heterogeneous in order to provide as many habitat opportunities as possible for various aquatic species. Some arms of the lagoon would be designed to have aquatic emergent wetland vegetation with soft fine-grained substrates; some arms would be gravelly bottomed with steep margins to provide woody riparian vegetation overhanging water two or more feet deep; and some arms would be created with gravelly substrates and gently sloping margins. Mixed deciduous/coniferous forest would surround the entire southern and western margins and fingers of the lagoon. Over time, this would provide shading to the lagoon to the maximum extent possible. The goal of the shading is to keep the water as cool as possible to preclude creating warm vegetated shallows, a preferred habitat for non-native bass.

3.4.2.5 Significant Unavoidable Adverse Fish Impacts

As discussed above, the shoreline features of the proposed action are designed to provide beneficial habitat for salmonids, and would not result in the loss of existing habitat. Therefore, the project would not have adverse effects on the targeted species and, if successful, would have positive effects.